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### (54) BLUNT TIP SURGICAL NEEDLE

CHIRURGISCHE NADEL MIT STUMPFER SPITZE

AIGUILLE CHIRURGICALE A EXTREMITE EMOUSSEE

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**Description****BACKGROUND OF THE INVENTION****5 Field of the Invention:**

The present invention relates generally to the field of surgical instruments and, more specifically, to surgical needles for suturing wounds.

**10 Description of the Art:**

In recent years, there has been an increasing awareness of the problems associated with accidental sticking of medical personnel with suturing and syringe needles. Before the advent of biological warfare contaminants and the spreading of infectious health hazards such as hepatitis B (HBV), human immunodeficiency virus (HIV) infection and 15 acquired immune deficiency syndrome (AIDS), the consequences of sustaining a needle stick wound were not considered serious. However, the knowledge that infectious diseases such as the AIDS virus can be spread by an accidentally inflicted needle-stick from a contaminated needle administered to a person having the AIDS virus has done much to change this belief. Accordingly, there has been an increasing amount of activity in the area of addressing this problem. For example, one prior art needle assembly contains a blunting member which is movable, either by fluid flow through 20 the needle or by mechanical pressure, from a retracted position in which the blunting member does not interfere with the puncture tip of the needle, to an extended position attained after use in which the blunting member extends beyond the puncture tip and thereby blunts the needle. The prior art discloses further examples of shield or guard type assemblies for syringe needles.

While the devices disclosed above and other similar type devices may be useful for hypodermic syringe needles 25 which are intended to be disposed of after a single "stick", it is not a practicable solution for use with surgical needles since such needles must make repeated "sticks" into the body. While surgeons are highly trained and skilled individuals, the possibility of an accidental stick from a surgical needle is still present. Even a highly skilled surgeon can eventually become tired or, as in trauma situations, in a hurry at the end of a long operation and thus more prone to such an occurrence. Then too, it is not uncommon that a less experienced individual in the operating room team is assigned to close 30 the wound.

The present invention is intended to decrease the potential transmission of all infectious agents, including those referred to above, in situations where accidental needle stick is the means for such transmission.

US-A-2008251, on which the two-part form of claim 1 has been delimited, discloses a curved surgical needle having 35 a blunt point for use in resections of the stomach and intestines and bronchocele operations; the nature of the blunt point is not disclosed.

US-A-2786619 discloses a lacing needle which may have a dull or sharp point according to the use for which the needle is intended.

**SUMMARY OF THE INVENTION**

40

According to the invention there is provided a surgical needle for use in suturing non-cutaneous soft tissues of the body, comprising:

a needle shaft; and  
45 a needle tip, said needle shaft and needle tip integrally formed of a rigid material suitable for use inside the body and containing no fluid passages therethrough, said needle tip having a continuously smooth outer surface lacking any sharp cutting edges, and a body portion integrally formed with and extending from said needle shaft, said body portion being tapered along the length thereof, said needle tip further having a blunt head adapted to penetrate muscle and fascia, muscle alone, adipose, pericostal tissue and other non-cutaneous soft tissues of the body while preventing skin penetration of the gloved hand of an operator wearing a surgical glove, wherein said blunt head has 50 a part spherical shape and a vertex which forms a portion of said part spherical shape, characterised in that said blunt head has a diameter of curvature which is in the range of 25% to 62% of the diameter of said needle shaft and said diameter of curvature is at least about 0.15 mm (0.006").

55 Accordingly, it is an object of the present invention to provide an improved surgical needle for use in suturing muscle and fascia, muscle alone, adipose, pericostal tissue and other non-cutaneous soft tissues of the body while at the same time significantly decreasing the probability of skin penetration of the gloved hand of an operator.

Related objects and advantages of the present invention will become more apparent by reference to the following figures and detailed description.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a graph showing the relationship between penetration force and needle bluntness using data obtained from Table I.

5 FIG. 2 is a graph showing the variation in difference in resistance to penetration between gloved plantar skin and abdominal rectus muscle as a function of needle bluntness using data obtained from Table III.

FIG. 3 is a graph showing the variation in average penetration force as a function of needle bluntness using data obtained from Table III.

FIG. 4 is a side view of a preferred embodiment of the surgical needle of the present invention.

10 FIG. 5 is an enlarged fragmentary view of the tip portion of the surgical needle of FIG. 4.

FIG. 6 is an enlarged cross-sectional view taken along lines 6-6 in Figure 4.

FIG. 7 is an alternative embodiment of the enlarged cross-sectional view taken along lines 6-6 in Figure 4.

FIG. 8 is an enlarged cross-sectional view taken along lines 8-8 in Figure 4.

## 15 DESCRIPTION OF THE PREFERRED EMBODIMENT

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

20 As used herein, the term "bluntness" is intended to refer to the relation between the diameter of curvature of the needle point or vertex to the diameter of the needle shaft. For comparison purposes, this relationship is expressed as a percentage. As an example, a needle having 50% bluntness is intended to describe a needle having a diameter of curvature at the vertex which is half the diameter of the needle shaft. The term "diameter of curvature" as used herein 25 describes the hypothetical diameter of a fully spherical surface coincident with the part spherical surface which forms the vertex, or forwardmost point, of the needle. Thus, a totally sharp needle, i.e., a needle having 0% bluntness, has zero curvature present at the needle vertex.

30 A number of tests were conducted to determine whether there existed a blunt needle point configuration which would permit relatively easy penetration of soft non-cutaneous body tissues while providing increased protection against an unintended stick of the gloved hand of the operator. These included tests to determine the penetration force as a function of "bluntness" in muscle/fascia and in gloved palmar skin.

35 In a first series of tests, four groups of test results were obtained corresponding to the following four test specimens: (1) abdominal rectus muscle/fascia, (2) gloved palmar skin, (3) abdominal rectus muscle/fascia vs. gloved plantar skin, and (4) intercostal muscle. In each group of tests, eight needle point configurations were tested having a bluntness of 0%, 25%, 37%, 50%, 62%, 75%, 87%, and 100%. A sample set of six needles per each configuration were used for each of the first, second and fourth groups of tests, making a total of 48 needles for each of these groups of tests. In the third group of tests, a sample set of twelve needles was used for each needle configuration, making a total of 96 needles for this test group. All needles were type T-20 surgical needles manufactured by the Davis & Geck Division of 40 American Cyanamid Company of Danbury, Conn., U.S.A. having a length of 48 mm (1.891"), a wire diameter of 1.27 mm (0.050"), and a curved shape having a radius of curvature along the needle shaft of 16.7 mm (0.656") and an included angle of 165 degrees.

45 The first group of test results for the abdominal rectus muscle/fascia was conducted as follows. The skin overlying the abdominal fascia of a single cadaver was opened and retracted. The supra-umbilical abdominal rectus muscle with its anterior and posterior sheaths was then excised from the cadaver. Using this specimen, the force of penetration was measured for each of the needles in the sample. A total of three passes were made for each needle. In each pass, penetration was made away from the midline of the specimen so that the penetration sequence would always be fascia, muscle, then fascia.

50 In the second group of tests, skin from the palms of the same cadaver used in the first series of tests was harvested. The area harvested was bounded proximally by the skin crease at the wrist and distally by the base of the digits. A standard latex procedure glove was placed over the skin specimen in order to simulate unintended puncture of the surgeon's hand. The penetration sequence was glove, epidermis, dermis, and lastly, the back side of the latex glove. As with the first group of tests, the force of penetration was measured for each of the needles in the sample, with a total of three passes being made for each needle.

55 The goal in the third group of tests was to directly compare the penetration force of gloved skin as compared to that of abdominal rectus muscle/fascia using the same needle. Since all usable palmar skin had been harvested from the test cadaver in performing the previous group of tests and another suitable cadaver was unavailable, plantar skin was harvested from the test cadaver's feet. This skin is similar to the skin of the palm in that both are thick skin areas. Only the central non-weight bearing portion of the plantar skin was used. The rectus muscle and fascia was harvested from

the same test cadaver from the umbilicus to just superior to the pubic bone. The rectus muscle/fascia tissue was penetrated first, followed by the gloved plantar skin. In order to assess the difference in penetration force of palmar skin versus plantar skin, several passes were made through some remaining palmar skin after the plantar skin had been penetrated. The results obtained indicated that the penetration force was approximately the same for the two skin specimens using the sharp (0% bluntness) needles, with the plantar penetration force increasing as the bluntness to the needle increased (approximately twice the penetration force was necessary with a 62% dull needle). Again, the force of penetration was measured for each of the needles in the sample. In this group of tests, one pass was made into both specimens with each needle.

For the fourth group of tests, intercostal muscle was harvested from the same cadaver from interspaces 3 through 5 at the mid-clavicular line. The specimen blocks also consisted of the pleural lining of the chest (parietal pleura). The force of penetration was measured for each of the needles in the sample, with a total of three passes being made for each needle.

Table 1 lists the results of each of the four groups of test results in this first series of tests. Each needle is identified in the table by the letter "D" prefixed by a number indicating the testing order. The penetration force is expressed in grams.

TABLE I

20 Group 1 results (Abdominal Rectus Fascia/Muscle):

	0%	25%	37%
25	4D 80, 120, 80 7D 120, 120, 120 19D 40, 80, 120 30D 80, 120, 80 38D 80, 80, 80 40D 40, 80, 120	3D 360, 680, 600 13D 840, 760, 1000 14D 640, 600, 600 20D 600, 520, 680 31D 680, 720, 800 36D 840, 640, 840	6D 880, 600, 600 9D 920, 1120, 1000 12D 720, 840, 880 26D 1160, 760, 720 27D 520, 840, 840 41D 800, 600, 920
30			
35			
40			
45			
	50%	62%	
35	5D 920, 960, 1080 11D 1560, 1000, 1080 25D 1040, 1160, 920 28D 1800, 1000, 1240 32D 720, 1120, 600 42D 920, 1400, 1360		2D 640, 720, 600 10D 2040, 1200, 1600 18D 1800, 1720, 1520 24D 1240, 1520, 1080 29D 1560, 920, 840 39D 1200, 1520, 1200
40			
	75%	87%	100%
50	8D 2520, 2440, 1520 17D 1520, 1880, 1600 22D 2440, 1320, 1520 33D 2000, 1840, 1400 46D 2120, 1760, 1800 47D 2620, 2720, 2480	15D 2680, 2280, 2560 21D 1760, 1960, 2120 34D 2480, 2160, 1800 35D 1760, 1560, 2240 43D 2640, 2800, 2920 45D 1680, 2760, 3160	1D 2920, 1200, 2040 16D 2400, 2760, 3080 23D 1920, 1680, 2160 37D 2280, 3000, 3600 44D 2520, 1880, 2400 48D 2920, 2440, 2400
55			

Group 2 results (Gloved Palmar Skin):

	0%	25%	37%
5	8A 300, 500, 300 10A 200, 200, 400 11A 600, 700, 700 12A 400, 400, 400 27A 300, 700, 800 31A 400, 600, 800 37A 400, 700, 600 66A 200, 300, 400 73A 100, 200, 200 83A 200, 300, 300	9A 900, 800, 500 14A 300, 800, 800 15A 700, 700, 900 44A 800, 800, 1000 61A 600, 800, 700 63A 900, 1400, 1200 65A 800, 800, 800 69A 1300, 1300, 900 74A 800, 700, 1100 97A 500, 500, 500	4A 800, 1200, 900 19A 800, 700, 800 23A 1200, 1300, 1700 32A 1000, 1000, 1200 33A 1200, 2000, 1800 35A 900, 1800, 800 42A 1600, 1500, 900 45A 800, 800, 1200 46A 1300, 1800, 1900 56A 900, 900, 1000
	85A 500, 400, 400 88A 200, 200, 200	81A 700, 600, 600 91A 500, 600, 600	59A 1000, 900, 1300 94A 900, 900, 1000
20		50%	62%
	1A 1840, 2240, 1600 6A 1100, 1200, 1100 18A 1500, 1500, 1300 26A 1400, 1800, 1300 34A 1700, 1600, 1600 48A 1600, 1500, 2000 54A 1400, 2300, 2200 57A 900, 1300, 1600 68A 1800, 1400, 1500 75A 1200, 1000, 1200		16A 1500, 1300, 1200 21A 1500, 2200, 2200 24A 2000, 1700, 1600 29A 1500, 1900, 1400 47A 2400, 2300, 3500 49A 3000, 2600, 2400 52A 1200, 1100, 2100 55A 1400, 1200, 1800 58A 1300, 1900, 2100 60A 900, 1200, 1000
	79A 1100, 1000, 1400 80A 1600, 1600, 2000		82A 1700, 1500, 1800 96A 2200, 2000, 2900
40		75%	87%
	2A 2900, 2800, 2700 3A 1600, 4500, 3900 7A 1800, 2200, 2700 20A 2200, 3200, 3200 36A 4800, 4500, 4200 38A 3200, 3500, 3600 50A 1900, 2400, 2000 53A 3100, 2200, 3100 71A 1400, 2300, 2000 72A 2100, 1800, 2600 78A 1800, 2000, 2300 86A 2100, 2200, 3500	5A 3600, 2300, 3600 13A 2700, 2400, 2300 17A 2700, 2900, 3300 28A 4600, 3100, 3000 39A 3900, 3000, 3200 41A 3300, 3500, 3400 64A 3900, 3200, 5500 76A 2400, 2600, 2800 84A 3800, 2800, 2700 89A 2200, 2000, 2200 93A 2300, 3000, 2100 95A 2400, 2900, 2800	22A 2400, 3000, 2900 25A 3100, 3600, 2300 30A 3400, 2800, 5600 40A 6000, 5100, 4000 43A 4900, 3200, 3400 51A 3100, 3000, 2900 62A 4900, 3100, 2700 67A 4900, 4500, 2900 70A 2800, 3300, 3200 87A 4200, 3200, 3000 90A 2500, 3400, 2700 92A 2800, 2400, 3300

Group 3 Results (Abdominal Rectus Muscle/Fascia vs. Gloved Plantar Skin):

	0%	25%	37%
5			
	8B 50, 350	7B 550, 1200	6B 500, 800
	9B 50, 400	10B 450, 1450	12B 350, 1600
	19B 50, 300	21B 350, 900	16B 600, 1350
10	28B 150, 450	37B 700, 1150	20B 450, 1200
	53B 200, 700	38B 450, 1100	24B 550, 1350
	54B 50, 450	51B 250, 1150	30B 450, 1250
	73B 100, 300	56B 300, 150	39B 350, 1050
	75B 50, 300	60B 500, 1600	45B 550, 1400
15	77B 50, 500	65B 550, 1400	48B 350, 1300
	90B 50, 400	83B 350, 1100	59B 800, 1750
	89B 100, 550	84B 700, 1200	68B 700, 1200
	91B 50, 250	85B 400, 1100	92B 400, 1200

20	50%	62%
25		
	1B 750, 2600	2B 650, 2450
	5B 600, 3050	11B 500, 2850
	13B 450, 1800	22B 850, 2400
	25B 600, 2400	34B 750, 2750
	32B 250, 2650	36B 850, 2500
	35B 350, 1150	41B 900, 2150
30	40B 1000, 1850	46B 600, 3100
	52B 500, 2450	61B 850, 2500
	67B 550, 1900	67B 1100, 3750
	70B 1400, 1750	79B 500, 3350
	78B 600, 2250	81B 700, 3300
35	87B 750, 2300	94B 250, 3000

	75%	87%	100%
40			
	4B 350, 3300	15B 700, 4850	3B 750, 5000+
	14B 1500, 3000	26B 800, 5000+	17B 700, 5000+
	18B 1150, 3600	29B 300, 4150	24B 1800, 5000+
45	23B 400, 3750	31B 900, 5000+	42B 300, 5000+
	33B 1400, 4250	44B 1050, 4900	49B 1000, 5000+
	43B 950, 3600	57B 1350, 5000+	62B 1550, 5000+
	47B 1100, 4750	58B 1300, 5000+	64B 750, 5000+
50	50B 700, 2150	69B 1300, 2950	74B 1200, 5000+
	55B 900, 4450	71B 2550, 4500	76B 600, 5000+
	66B 900, 4950	80B 1350, 5000+	82B 1000, 5000+
	72B 1900, 4500	88B 900, 5000+	86B 1550, 5000+
	93B 1050, 4650	96B 1700, 4450	95B 1150, 5000+

Group 4 Results (Intercostal Fascia/Muscle):

	0%	25%	37%
5			
	21C 40, 80, 80	9C 720, 480, 200	13C 800, 1000, 440
	24C 40, 40, 80	15C 360, 200, 280	16C 320, 440, 480
10	36C 160, 200, 120	19C 200, 480, 200	20C 600, 440, 840
	41C 80, 80, 80	34C 520, 240, 320	30C 200, 360, 280
	43C 80, 80, 40	37C 400, 520, 200	31C 400, 560, 320
	48C 40, 80, 40	39C 400, 240, 320	45C 440, 480, 480

15

	50%	62%
20		
	8C 1040, 1440, 520	3C 880, 640, 600
	14C 720, 480, 600	10C 480, 480, 880
25	22C 400, 400, 760	11C 1200, 880, 1600
	27C 400, 320, 720	17C 800, 840, 840
	29C 520, 480, 400	26C 720, 480, 440
	42C 360, 440, 480	40C 400, 440, 720

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	75%	87%	100%
40			
	1C 1000, 880, 960	5C 1800, 920, 1160	4C 960, 1960, 1320
	2C 1200, 600, 920	7C 1760, 2400, 1080	32C 1600, 760, 800
	6C 920, 1200, 1600	23C 520, 600, 1000	35C 1840, 1800, 1000
45	12C 560, 1560, 760	28C 720, 1520, 1520	44C 1120, 720, 560
	18C 520, 960, 560	33C 1360, 1000, 840	46C 880, 1600, 1000
	25C 200, 480, 1120	38C 1400, 720, 600	47C 1720, 1160, 1360

50 The data set forth in Table I is shown in graph form in Figure 1, wherein resistance to penetration is plotted along the vertical axis and degree of tip bluntness, expressed as a percentage, is plotted along the horizontal axis. Proceeding from uppermost to lowest, the four curves in Figure 1 correspond to gloved plantar skin, gloved palmar skin, abdominal rectus muscle, and intercostal muscle, respectively. As can be seen with reference to Figure 1, at all bluntness settings both gloved palmar skin and gloved plantar skin exhibit a greater resistance to penetration than do abdominal rectus fascia/muscle or intercostal fascia/muscle. Further, as can be seen with reference to Figure 2, the difference in penetration force between gloved skin (plantar) and fascia/muscle (abdominal rectus) remains about the same for needle bluntness in the range between about 0 and 25%. However, as the degree of needle bluntness approaches about 25%, the difference in penetration force between gloved skin (palmar) and fascia/muscle (abdominal rectus) begins to increase. This difference in penetration force continues to increase throughout the remaining range of needle bluntness.

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It is also perceived from these tests that at bluntness settings greater than about 62% the resistance to penetration of the type needle becomes sufficiently great in abdominal rectus and intercostal fascia/muscle that usage would be disfavored.

In a second series of tests, needles having bluntness settings in a range from 25% to 62% were tested in comparison with totally sharp needles having 0% bluntness. The specific bluntness settings tested were 0%, 25%, 37%, 50%, and 62%. Thirty-two penetration measurements were taken at each bluntness setting, broken into four test series identified as A, B, C and D. Each test series was done on a single cadaver. For each test, a needle was passed through muscle fascia and the required penetration force was recorded. Thus, this series of tests involved 160 needles. Table II shows the raw data obtained while Table III presents a statistical summary of the results of these tests. Figure 3 is a graph showing the variation in average penetration force as a function of needle bluntness using data obtained from Table III. In Table III "Avg" refers to the average force of penetration expressed in grams of the thirty-two tests conducted at each bluntness setting, while "SD" refers to the standard deviation of the test results.

15 TABLE II

	Cadaver	Bluntness Setting	Abdom Rectus Muscle/Fascia	Gloved Palmar Skin	Difference
20	A	0%	80.0	340.0	260.0
	B	0%	80.0	225.0	145.0
	C	0%	145.0	285.0	140.0
	D	0%	65.0	210.0	145.0
25	A	25%	345.0	835.0	490.0
	B	25%	375.0	845.0	470.0
	C	25%	860.0	1355.0	495.0
	D	25%	350.0	775.0	425.0
30	A	37%	515.0	925.0	410.0
	B	37%	400.0	1000.0	600.0
	C	37%	1040.0	1660.0	620.0
	D	37%	465.0	1080.0	615.0
35	A	50%	910.0	1480.0	570.0
	B	50%	555.0	1370.0	815.0
	C	50%	1450.0	2400.0	950.0
	D	50%	665.0	1145.0	480.0
40	A	62%	595.0	1420.0	825.0
	B	62%	695.0	1610.0	915.0
	C	62%	1755.0	3495.0	1740.0
	D	62%	775.0	1930.0	1155.0

TABLE III

Bluntness Setting	Muscle/Fascia	Gloved Skin	Difference
0%	Avg = 92.5	Avg = 265.0	Avg = 172.5
	SD = 41.2	SD = 70.9	SD = 69.2
25%	Avg = 482.5	Avg = 952.5	Avg = 470.0
	SD = 298.6	SD = 350.8	SD = 274.1
37%	Avg = 605.0	Avg = 1166.3	Avg = 561.3
	SD = 325.6	SD = 399.2	SD = 350.8
50%	Avg = 895.0	Avg = 1598.8	Avg = 703.8
	SD = 492.7	SD = 605.7	SD = 445.6
62%	Avg = 955.0	Avg = 2113.8	Avg = 1158.8
	SD = 538.5	SD = 969.4	SD = 619.6

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It is perceived that the degree of safety provided to an operator by a particular needle configuration is directly related to the magnitude of difference in the penetration force needed to pierce the target body tissues and the gloved hand of the operator. As is indicated by the data in Table III, a totally sharp needle having 0% bluntness requires an average of 172.5 grams greater penetration force to penetrate gloved skin as compared to muscle fascia. This "safety factor" of 172.5 grams is of course insufficient in many instances in preventing accidental sticks of the gloved hand of the operator. The Table III results show that needles having a bluntness in the 25-62% range exhibit a much greater magnitude of difference in the penetration force needed to pierce the target body tissues and the gloved hand of the operator than sharp needles (i.e., needles having 0% bluntness).

Table IV indicates the average percent improvement in the safety factor provided by 25-62% blunt needles over sharp (0% blunt) needles, based on the Tables II and III data. The average percent improvement in the safety factor is defined by the following formula wherein  $A_{sf}$  is the average percent improvement in the safety factor,  $P_b$  is the average gloved skin penetration force at bluntness setting b, and  $P_o$  is the average gloved skin penetration force for a sharp (0% blunt) needle:

$$A_{sf} = (P_b/P_o) \times 100$$

TABLE IV

Bluntness Setting	$P_o$	$P_b$	Improvement
25%	265.0	952.5	359.4%
37%	265.0	1166.3	440.1%
50%	265.0	1598.8	603.3%
62%	265.0	2113.8	797.6%

Table V shows the minimum percent improvement in safety, defined by the following formula:

$$M_{sf} = (P_b^*/P_o) \times 100$$

55

In the above formula,  $M_{sf}$  is the minimum percent improvement in the safety factor.  $P_b^*$  is the minimum gloved skin penetration force at bluntness setting b calculated by subtracting the standard deviation in penetration force at bluntness setting b from the average penetration force at bluntness setting b. Thus, 84% of the penetrations at bluntness setting b will be higher than  $P_b^*$ .  $P_o$  is the average gloved skin penetration force for a sharp (0% blunt) needle.

TABLE V

Bluntness Setting	P <sub>0</sub>	P <sub>b</sub> *	Improvement
25%	265.0	601.7	227.1%
37%	265.0	767.1	289.5%
50%	265.0	993.1	374.8%
62%	265.0	1144.4	431.8%

5 A preferred embodiment of the surgical suture needle of the present invention, incorporating the desired safety  
15 characteristics is generally indicated at 10 in Figures 4 and 5. The needle 10 has a shaft portion 11 having a uniform  
outer diameter, and a tip portion 12 integrally formed with shaft portion 11 and extending distally therefrom. In order to  
provide stability and control of the needle 10 during use, the shaft portion 11 may have a flat pressed circular cross section  
such as shown in Figure 6 or, alternatively, a modified square cross sectional shape such as shown in Figure 7. In  
the needle 10 of Figure 4 the shaft portion 11 is curved and possesses a constant radius of curvature. This configura-  
20 tion is, however, not critical to the present invention and shaft portion 11 may therefore assume any straight and/or  
curved configuration which is considered suitable for the particular purpose that is intended. Both the shaft portion 11  
and tip portion 12 are rigidly formed of a suitable material for suture needle use inside the body, such as surgical grade  
steel. The needle tip portion 12 has an essentially circular cross sectional shape, as shown in Figure 8, and a tapered  
25 body 14. The needle tip portion 12 terminates in a blunt head 16 which is configured to permit piercing of muscle and  
fascia, muscle alone, adipose, pericostal tissue and other non-cutaneous soft tissues of the body while preventing skin  
penetration of the gloved hand of an operator. As can be best appreciated with reference to Figure 5, head 16 preferably  
has a part spherical shape which encompasses vertex 17 of tip portion 12. Other curved shapes may also be employed  
as suitable configurations for head 16, so long as there are no sharp edge surfaces.

It should be noted that the surgical needle of the present invention is specifically designed such that it is not suitable  
30 for suturing cutaneous tissues. Accordingly, based upon the test results obtained, it is considered important that blunt  
head 16 have a minimum diameter of curvature which is at least 25% of the diameter of the needle shaft portion 11 and  
a maximum diameter of curvature which is no greater than about 62% of the diameter of the needle shaft. Within this  
range, it is perceived that needles having a bluntness which is toward the higher end of the range will be especially pre-  
35 ferred as they offer a greater safety factor while still being acceptable for use. Further, the diameter of the needle shaft  
should be in a range of about 0.66 mm to 1.27 mm (0.026" to 0.050") with the diameter of curvature of the needle tip  
ranging between about 0.15 mm to 0.79 mm (0.006" to 0.031"). In addition, it is considered critical that the entire needle  
tip portion has a continuously smooth outer surface lacking any discontinuities or sharp cutting edges.

In practice, the surgical suture needle of the present invention may be used to close non-cutaneous soft tissues of  
the body employing the same techniques used with conventional suture needles. However, since the cutaneous tissues  
40 of the wound cannot be closed with the blunt tip needle, another closing technique must be used to complete the wound  
closure. This does not pose a problem, however, in that it is quite common to employ different closing techniques for  
closing the cutaneous and non-cutaneous tissues in a wound. For example, the needle of the present invention may be  
used to close the non-cutaneous tissues while final closure of the cutaneous tissues may be accomplished by conven-  
tional stapling techniques.

45 It is perceived that the blunt needle of the present invention may, in addition to reducing the risk of infectious dis-  
ease transmission by reducing the risk of an accidental needle stick, also serve to reduce the risk of needle contamina-  
tion by reducing the amount of bleeding caused by the needle. Decreased bleeding occurs because the blunt needle is  
more likely to simply push blood vessels aside rather than penetrate them as it is being advanced in the body.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same  
50 is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment  
has been shown and described and that all changes and modifications that come within the scope of the claims hereof  
are desired to be protected.

#### Claims

55 1. A surgical needle (10) for use in suturing non-cutaneous soft tissues of the body, comprising:  
a needle shaft (11); and  
a needle tip (12), said needle shaft (11) and needle tip (12) integrally formed of a rigid material suitable for use

inside the body and containing no fluid passages therethrough, said needle tip (12) having a continuously smooth outer surface lacking any sharp cutting edges, and a body portion (14) integrally formed with and extending from said needle shaft (11), said body portion (14) being tapered along the length thereof, said needle tip (12) further having a blunt head (16), wherein said blunt head (16) has a part spherical shape and a vertex which forms a portion of said part spherical shape, characterised in that said blunt head (16) has a diameter of curvature which is in the range of 25% to 62% of the diameter of said needle shaft and said diameter of curvature is at least about 0.15 mm (0.006"), whereby said blunt head is adapted to penetrate muscle and fascia, muscle alone, adipose, pericostal tissue and other non-cutaneous soft tissues of the body while preventing skin penetration of the gloved hand of an operator wearing a surgical glove.

10 2. The surgical needle of claim 1 wherein the diameter of said needle shaft (11) is in a range of about 0.66 mm to 1.27 mm (0.026" to 0.050") and the diameter of curvature of said needle tip (12) is no greater than about 0.79 mm (0.031").

15 3. The surgical needle of claim 1 or claim 2, wherein said needle tip has a generally circular cross-section.

4. The surgical needle of claim 3 wherein said needle shaft has a generally flat pressed circular cross-section along at least a portion of the length in order to facilitate stability in a needle holder.

20 5. The surgical needle of any preceding claim having a blunt tip formed so as to provide a safety factor of at least 200% over a needle having 0% bluntness.

6. The surgical needle of any preceding claim having a blunt tip formed so as to provide a safety factor of between about 200% to 800% over a needle having 0% bluntness.

25 **Patentansprüche**

1. Chirurgische Nadel (10) zum Einsatz beim Nähen von nichtkutanem, weichem Körpergewebe, welche folgendes aufweist:

30 einen Nadelschaft (11); und  
ein Nadelende (12), wobei der Nadelschaft (11) und das Nadelende (12) integral aus einem steifen Material ausgebildet sind, das für den Einsatz im Inneren des Körpers geeignet ist und keine durchgehenden Fluid-durchgänge enthält, wobei das Nadelende (12) eine durchgehende, gleichmäßige, äußere Fläche hat, welche keinerlei scharfe Schneidkanten besitzt, und ein Körperteil (14), welches integral mit dem Nadelschaft (11) ausgebildet ist und sich in Verlängerung hiervon erstreckt, wobei das Körperteil (14) in Längserstreckung hier-von konisch ausgebildet ist, wobei das Nadelende (12) ferner einen stumpfen Kopf (16) hat, wobei der stumpfe Kopf (16) ein Teil mit einer kugelförmigen Gestalt und einen Scheitel besitzt, welcher einen Teil der teilweise kugelförmigen Gestalt bildet, dadurch gekennzeichnet, daß der stumpfe Kopf (16) einen Krümmungsdurch-messer hat, welcher in einem Bereich von 25 % bis 62 % des Durchmessers des Nadelschafts liegt, und wobei der Krümmungsdurchmesser wenigstens etwa 0,15 mm (0,006") beträgt, wobei der stumpfe Kopf dazu geeig-net ist, einen Muskel und Muskelfascien, den Muskel allein, adipöses, Pericostalgewebe und nichtkutanes, weiches Körpergewebe zu durchdringen, während ein Durchdringen der Haut der mit Handschuhen versehe-nen Hand eines Chirurgen verhindert wird.

45 2. Chirurgische Nadel nach Anspruch 1, wobei der Durchmesser des Nadelschafts (11) in einem Bereich von etwa 0,66 mm bis 1,27 mm (0,026" bis 0,050") liegt und der Krümmungsdurchmesser des Nadelendes (12) nicht größer als etwa 0,79 mm (0,031") ist.

50 3. Chirurgische Nadel nach Anspruch 1 oder Anspruch 2, wobei das Nadelende einen im allgemeinen kreisförmigen Querschnitt hat.

4. Chirurgische Nadel nach Anspruch 3, wobei der Nadelschaft einen allgemein flachen, gepreßten, kreisförmigen Querschnitt entlang wenigstens einem Teil der Länge hat, um eine Stabilität in einem Nadelhalter zu ermöglichen.

55 5. Chirurgische Nadel nach einem der vorangehenden Ansprüche mit einem stumpfen Ende, das derart ausgebildet ist, daß man einen Sicherheitsfaktor von wenigstens 200 % gegenüber einer Nadel erhält, welche eine Stumpfheit von 0 % hat.

6. Chirurgische Nadel nach einem der vorangehenden Ansprüche mit einem stumpfen Ende, das derart ausgebildet ist, daß man einen Sicherheitsfaktor von zwischen etwa 200 % bis etwa 800 % gegenüber einer Nadel erhält, welche eine Stumpfheit von 0 % hat.

5 **Revendications**

1. Aiguille chirurgicale (10) destinée à être employée pour suturer des tissus mous non-cutanés du corps, qui comprend :

10        une tige d'aiguille (11),  
et une pointe d'aiguille (12), cette tige d'aiguille (11) et cette pointe d'aiguille (12) étant intégralement formée d'un matériau rigide approprié pour servir à l'intérieur du corps et ne contenant pas de passage de fluide à travers celui-ci, cette pointe d'aiguille (12) ayant une surface externe lisse d'une manière continue dépourvue d'angle coupant aigu et une partie de corps (14) formée intégralement avec elle et s'étendant à partir de cette tige d'aiguille (11), cette partie de corps (14) étant amincie le long de sa longueur, cette pointe d'aiguille (12) ayant encore une tête émoussée (16), dans lequel cette tête émoussée (16) a une forme en partie sphérique et un vertex qui forme une partie de cette formation en partie sphérique, caractérisée en ce que  
20        cette tête émoussée (16) a un diamètre de courbure qui est dans la gamme de 25 à 62 % du diamètre de cette tige d'aiguille et ce diamètre de courbure est au moins environ de 0,15 mm (0,006") par lequel cette tête émoussée est adaptée pour pénétrer les muscles et les fascia (fines couches de tissus), le muscle seul, les tissus adipeux, le tissu péricostal, et d'autres tissus mous non cutanés du corps tout en empêchant une pénétration de la peau de la main gantée d'un opérateur portant un gant chirurgical,

25        2. Aiguille chirurgicale selon la revendication 1, caractérisée en ce que  
le diamètre de cette tige d'aiguille (11) est dans la gamme allant de 0,66 mm à 1,27 mm (0,026" à 0,050") environ et le diamètre de courbure de cette pointe d'aiguille (12) n'est pas plus grand que 0,79 mm (0,031") environ.

30        3. Aiguille chirurgicale selon la revendication 1 ou la revendication 2, caractérisée en ce que  
cette pointe d'aiguille a une section transversale généralement circulaire.

35        4. Aiguille chirurgicale selon la revendication 3, caractérisée en ce que  
cette tige d'aiguille a une section transversale comprimée circulaire en général plate le long d'au moins une partie de la longueur de façon à faciliter une stabilité dans un porte-aiguille.

40        5. Aiguille chirurgicale selon l'une quelconque des revendications précédentes ayant un bout émoussé formé de façon à fournir un facteur de sécurité d'au moins 200 % par rapport à une aiguille ayant 0 % de caractère d'épointage.

45        6. Aiguille chirurgicale selon l'une quelconque des revendications précédentes ayant un bout émoussé formé de façon à fournir un facteur de sécurité d'environ 200 % à 800 % par rapport à une aiguille ayant 0 % de caractère d'épointage.

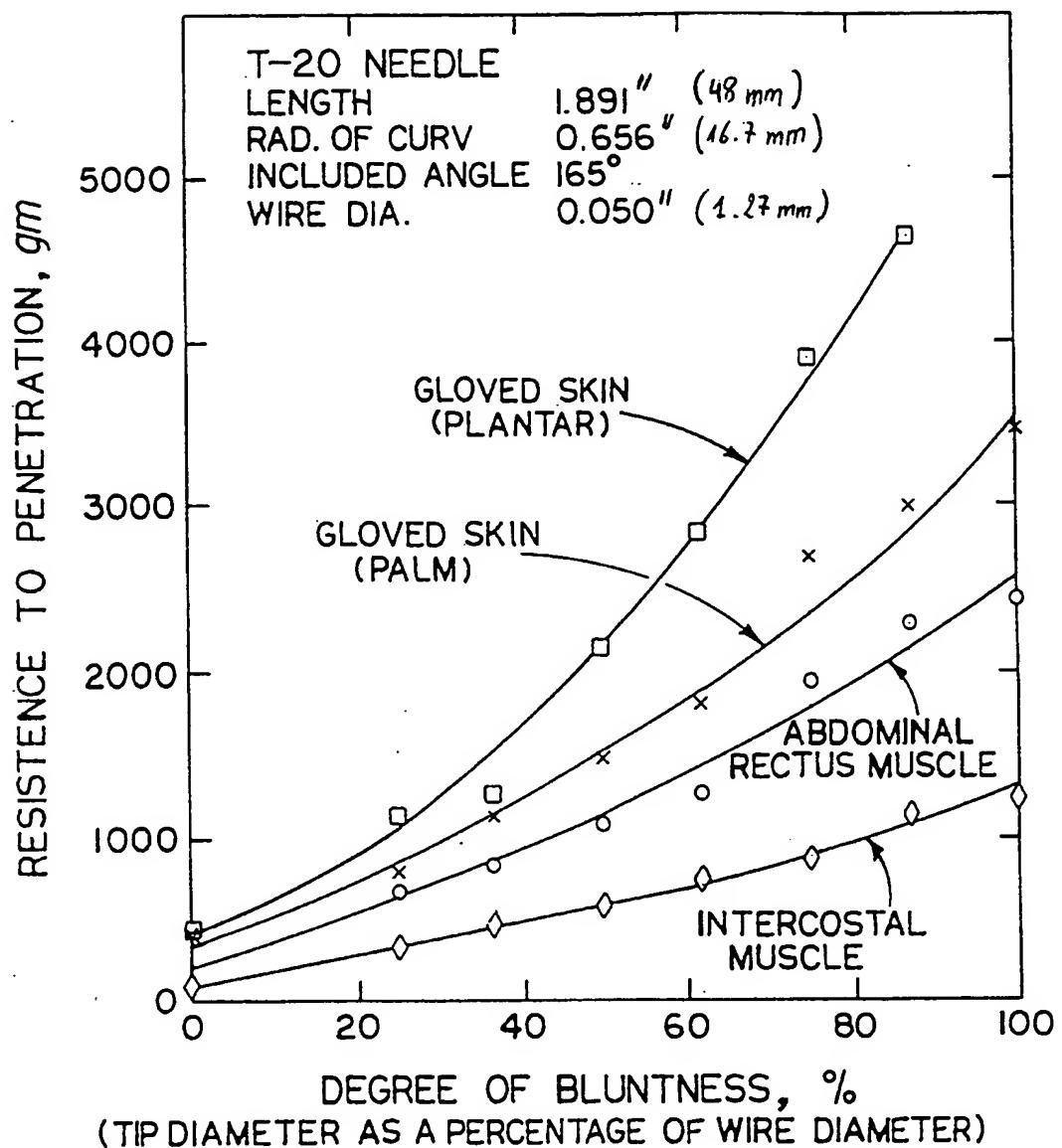


Fig. 1

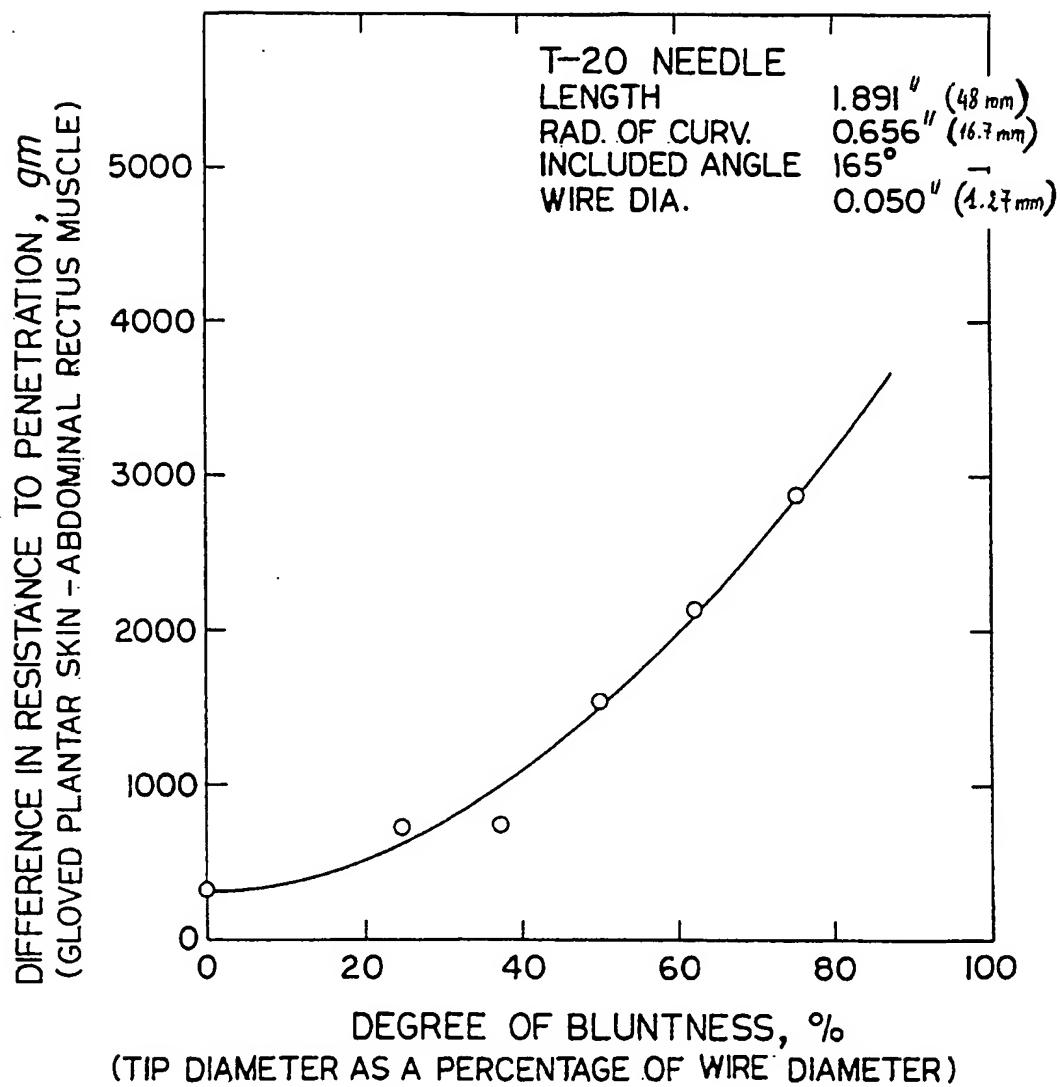


Fig. 2

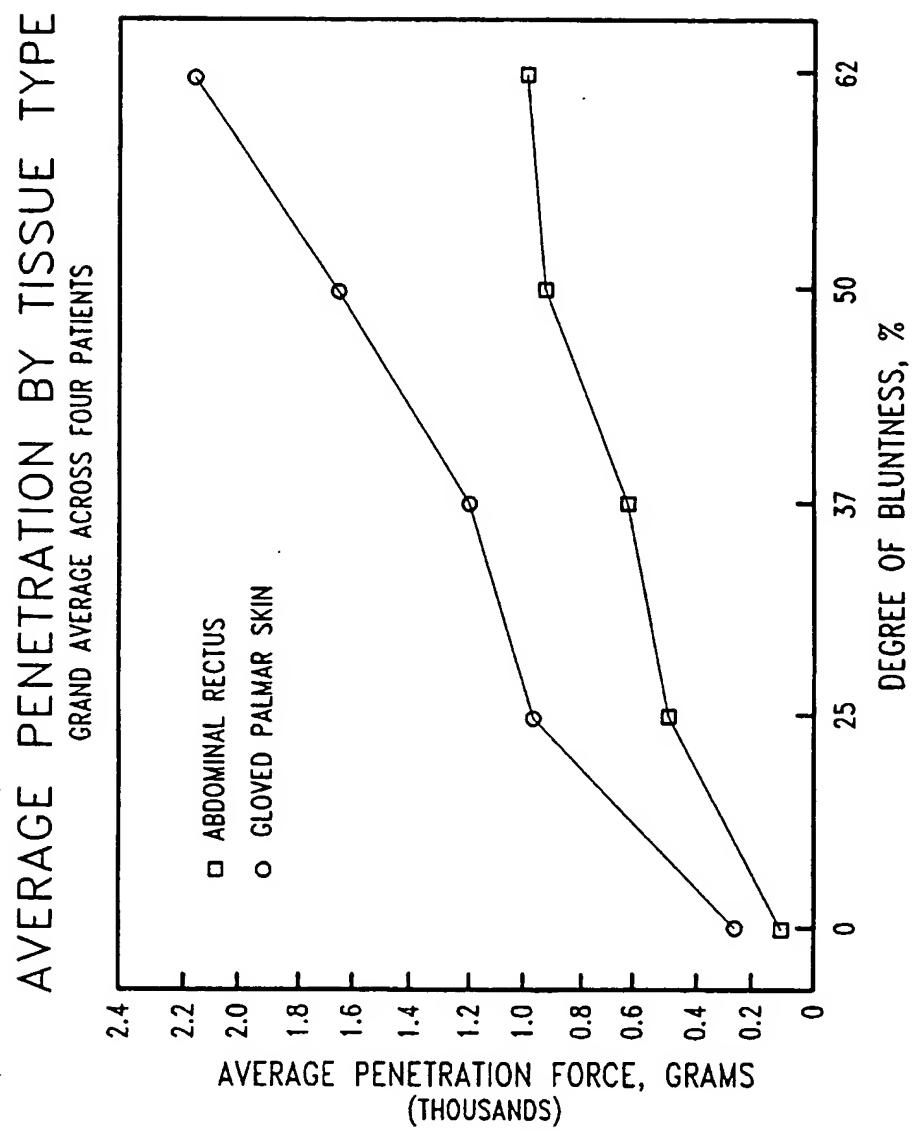


Fig. 3

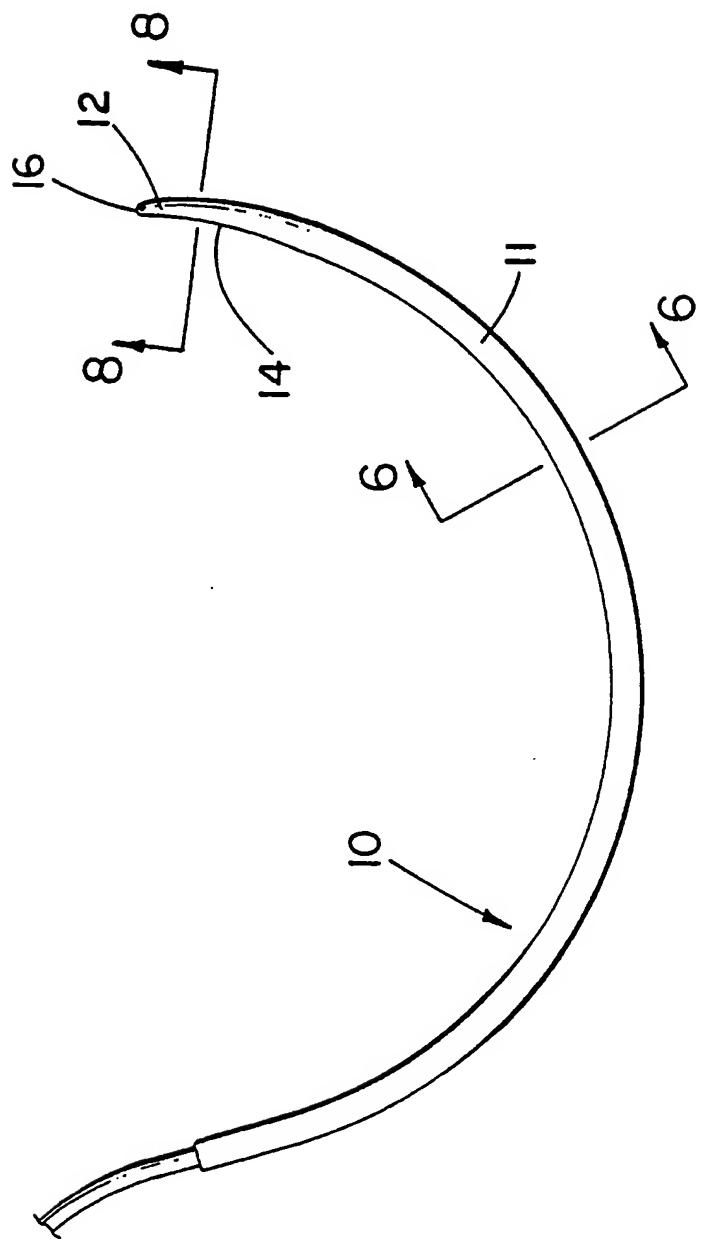


Fig. 4

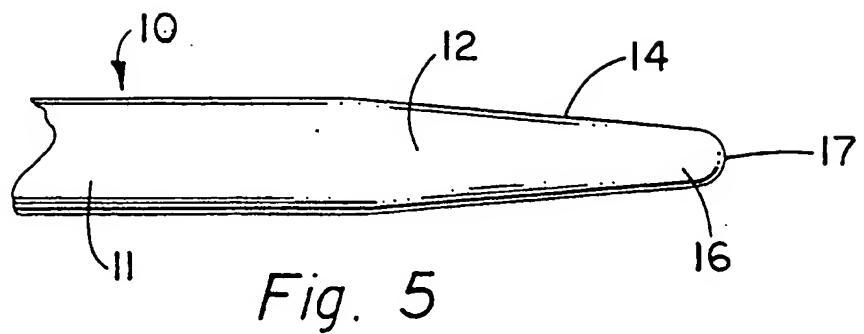


Fig. 6



Fig. 8

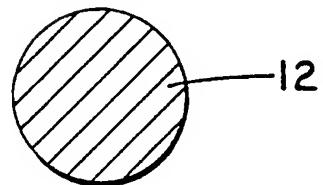


Fig. 7

